

A Freshwater Bryozoan, *Hyalinella vaihirieae* Hastings (1929), from Hawaiian Prawn Ponds¹

JULIE H. BAILEY-BROCK² AND PETER J. HAYWARD³

ABSTRACT: The occurrence of *Hyalinella vaihirieae* Hastings (1929) in ponds for culturing freshwater prawns at Kekaha, Kauai, represents a new record to the Hawaiian fauna and the second record of a phylactolaemate bryozoan from the islands. This represents the fourth record of this species which was first described from a lake at 427 m elevation on Tahiti. The known distribution also includes E. Australia and Utah, United States. The bryozoan was found growing in a broad band to a depth of 60 cm attached to vegetation around the banks of the ponds. Specimens collected in both May and August 1982 contained statoblasts, but they were much more numerous in the August material. In the laboratory adult prawns were observed to feed on the bryozoan which grew more luxuriantly in ponds holding a reduced standing crop of prawns. The prawn ponds at Kekaha, Kauai, are no longer operational so the exact status of this species in Hawaii is not known.

PHYLACTOLAEMATE BRYOZOANS ARE EXCLUSIVELY freshwater inhabitants and are found in lakes and streams from sea level to high elevations on most continents (Bushnell 1973). They are hermaphroditic and reproduce sexually by cross fertilization, or asexually by forming statoblasts. These structures are resistant to harsh environmental conditions and function as a dispersal mechanism (Oda 1979).

Specimens of *Hyalinella vaihirieae* Hastings (1929) were collected in May and August 1982 from a freshwater prawn (*Macrobrachium rosenbergii*) farm at Kekaha, Kauai. This was an extensive commercial operation with 18 hectares of ponds located at sea level on the leeward coast of the island. Ponds on the farm were approximately 0.45 hectares in surface area and 0.76 to 1.2 m in depth with a fine mud bottom. A wellwater source supplied the ponds with water of less than 1 percent salinity, and the surface temperature ranged from

21 to 31°C during the year. The bryozoan grew in arborescent tufts attached to vegetation around the edges of the ponds and extended from the surface to a depth of approximately 60 cm. Numerous solitary hydrozoans (*Hydra* sp.) were growing on the surface of the bryozoan (Figure 1B). Since these specimens were collected, the farm has closed. The remaining ponds are empty except after periods of heavy rain. The exact status of the bryozoan at this site, or at other prawn ponds on Kauai, is not known.

MORPHOLOGY

Specimens of *Hyalinella vaihirieae* from both May and August collections were identified by Peter Hayward and have been deposited at the Bernice P. Bishop Museum (BPBM Cat. No. K471). The colonies grow in substantial clumps 7–10 cm in height formed from dense bundles of light brown tubes. At their free distal ends the tubes diverge as a series of single actively growing branches, and the colony has a finely divided appearance around the periphery. The growing branch comprises a single linear series of autozooids, each budded from the ventral, or abanal, surface of

¹ Hawaii Institute of Marine Biology Contribution No. 692. Manuscript accepted 30 April 1984.

² University of Hawaii, Zoology Department, Honolulu, Hawaii 96822.

³ University College of Swansea, Zoology Department, Swansea SA 2 8PP, Glamorgan, Wales, United Kingdom.

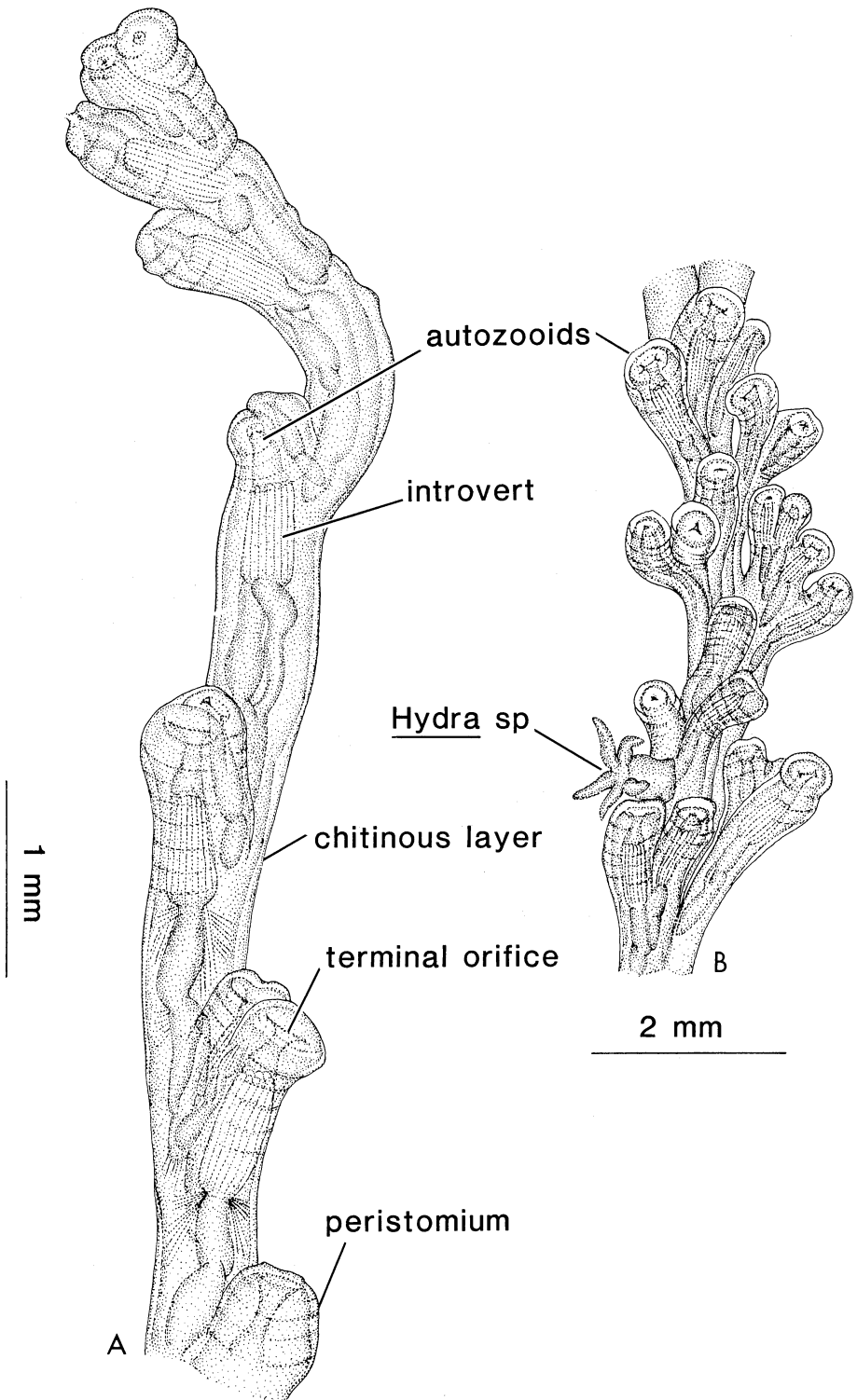


FIGURE 1. *Hyalinella vaihiriae*: A. distal portion of a growing branch, B. a later ontogenetic stage; note *Hydra* sp.

its predecessor. The peristomial portion of the autozoid, 0.5–0.8 mm long and bearing the terminal orifice, projects from the long axis of the branch. The body wall is stiffened by an outer chitinous layer (Hyman 1959), overlain at the distal end of the autozoid by a transparent gelatinous layer up to 0.2 mm thick. Within the orifice is a pleated introvert, and the peristomial region generally is marked by annular wrinkles and folds (Figure 1A). In older parts of the colony the gelatinous layer is less evident.

In young growing branches the orifices of fully developed primary autozooids are spaced 1–2 mm apart. However, each primary autozoid has an advanced, secondary, zoid bud closely associated with it (Figure 1A) and a smaller adventitious bud between it and the advanced bud. Growth continues through further distal elongation of the branch and by development of the secondary zoid buds, which are supplanted by development of the adventitious buds. As the secondary buds increase in size they produce their own advanced buds, together with smaller adventitious buds. Thus, peripheral branches of the colony develop fan-shaped groups of autozooids, forming whorls around part or all of the branch axis (Figure 1B). In later growth stages the autozooids that compose the fans lengthen, entwine, and become closely apposed, forming the rigid bundles of tubes seen in the older parts of the colony. However, as the developmental sequence of every zoid includes the initiation of two other zoid buds, even the oldest and most densely tangled parts of the colony bear groups of newly differentiated autozooids together with their accompanying buds. There are no septa between autozooids, the coelom being confluent throughout the colony, and the polypide of each zoid usually extends proximally into the proximal portion of the tube of the preceding zoid. The polypide is 2–3 mm long, the retracted lophophore measuring 0.7 mm.

The statoblasts (Figure 2A) are oval and biconvex, with one surface being slightly more convex than the other. The light horn-colored capsule is regularly oval and has a finely reticulate surface. The annulus is more elongate and less regular, with its two poles frequently

pinched laterally; thus it is narrowest along the sides of the capsule and broadens to about three times its width at the poles (Figure 2B). The annulus overlaps onto the capsule, markedly so on the less convex side, so that the edge of the latter is indicated by a dark line. Statoblasts measured 0.34–0.43 mm. ($\bar{x} = 39.2 \pm 1.74$, $n = 50$) \times 0.23–0.27 mm. ($\bar{x} = 24.56 \pm 1.01$, $n = 50$) mm.

The taxonomy of this phylactolaemate species is often regarded as questionable. Wiebach (1973) doubted the status of *Hyalinella vaihirieae* as a distinct species and regards it as synonymous with *Plumatella repens* (L.). However, both Lacourt (1968) and Bushnell (1973) considered it valid.

STATOBLASTS AND DISTRIBUTION

Statoblasts are the primary means of geographical dispersal for freshwater bryozoans (Bushnell 1973). Viable statoblasts have been found in the gut contents of cold-blooded vertebrates, and in the mud on bird's feet and bills (Bushnell 1973). The statoblasts of *Hyalinella vaihirieae* develop in the coelom and on release float at the water's surface to be dispersed by currents. There are a number of ways that statoblasts may spread between commercial prawn ponds and to other freshwater areas. They may pass between ponds in the plumbing system, on seine nets used to harvest the prawns, and on the feet of birds and of men working in the ponds. More passively, they may be blown across the water's surface or become airborne. Statoblasts of many freshwater bryozoans remain viable in mud and can withstand dessication before germinating under favorable conditions (Oda 1979).

The specimens collected in May 1982 comprised empty tubes packed with statoblasts, a high proportion (perhaps 70 percent) of which were germinating. The August samples were luxuriant, actively growing colonies. In these the oldest parts of the colonies had lost their polypides, and the tubes were filled with clumps of mature statoblasts. Statoblast production was continuing through all other regions of the colony, but there was no evidence of sexual reproduction.

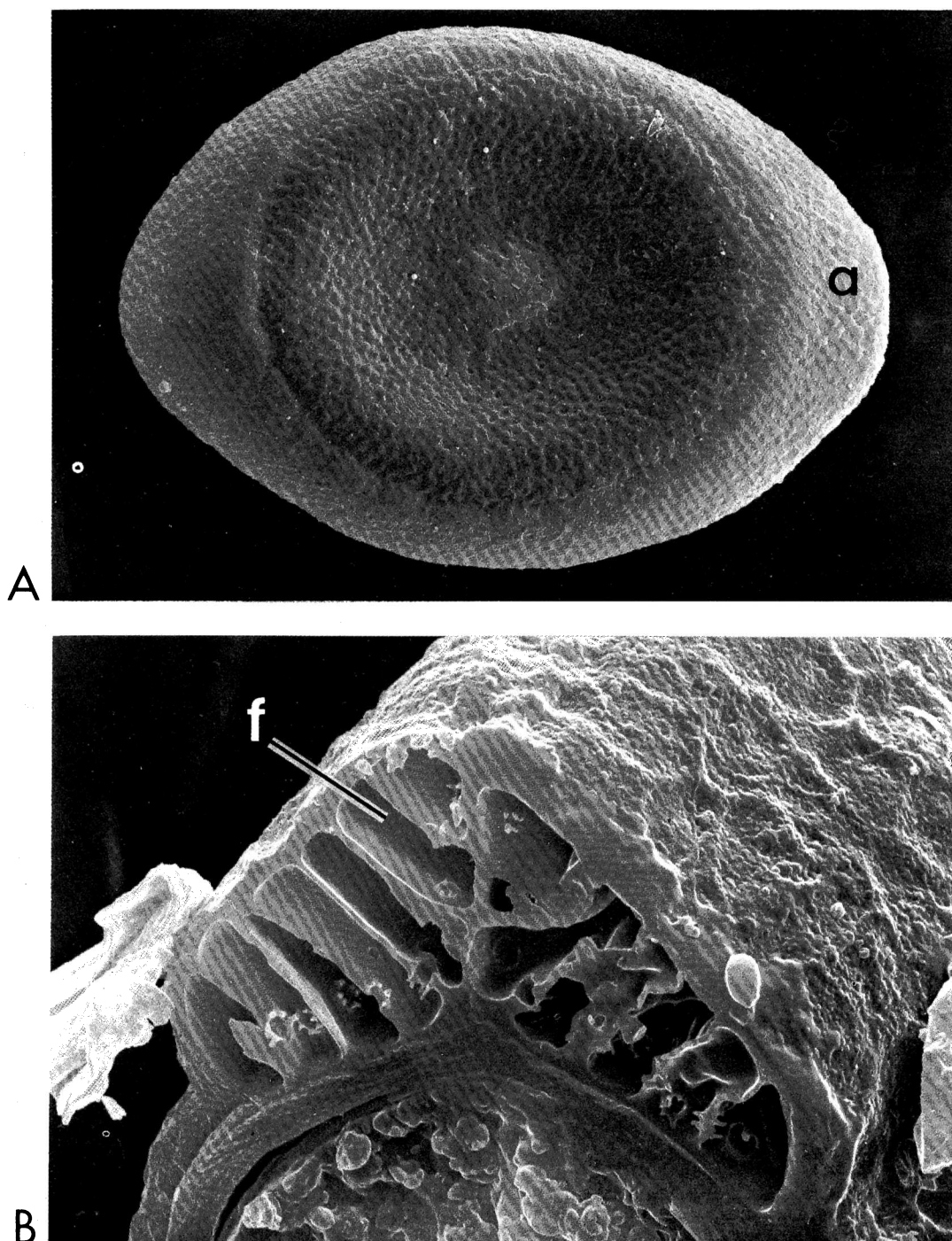


FIGURE 2. *A.* the statoblast (*a* = annulus), *B.* detail of fractured annulus showing float chambers (*f*). *A* $\times 280$, *B* $\times 1500$.

ZOOGEOGRAPHY

Hyalinella vaihirieae was described by Hastings (1929) from Lake Vaihira, Tahiti, which has an altitude of 427 m. Judging from Hastings' account the lake was quite oligotrophic, and *H. vaihirieae*, together with another phylactolaemate, *Plumatella emarginata* Allman, formed a thick mossy band along its shore. Subsequently, Rogick and Brown (1942) described material from Bear River, Utah, which they considered to be identical to Hastings' species, and Lacourt (1968) reported a single occurrence from Oxley Creek, Brisbane, Australia. The Hawaiian specimens have been compared with those from Tahiti preserved at the British Museum (Natural History) (reg. no. 1928.12.8.3.,9) and have been found to agree in all respects. Hastings (1929) stated that the very abundant statoblasts she found were of the "F" type (Lacourt 1968), that is, were floating freely in the body cavities of the zooids, and she could find no sessile ("S") types, which would have been cemented to the zooid tubes. The present material also had only free statoblasts, although Rogick and Brown (1942) described a sessile type in the North American animals, rather different in appearance from those in the Tahitian and Hawaiian specimens. It is of interest that the present records constitute only the fourth occurrence of the species, and the second description of a phylactolaemate bryozoan from the Hawaiian Islands.

A species of *Plumatella* was recorded from Green Lake, Hawaii (Maciolek 1982), but the material was not identified by a specialist and could have belonged to either *Plumatella* or *Hyalinella*, genera which are easily confused by the nonspecialist. Maciolek first collected a freshwater bryozoan (*Plumatella repens*?) in 1966 from leeward Koolau streams on Oahu and later found it on Maui where it clogged pond effluent pipes of an aquaculture facility, and on Oahu in reservoirs and streams (Maciolek, pers. comm.).

DISCUSSION

Bryozoans or other sessile colonial organisms can be a nuisance to prawn farmers when

growing luxuriantly inside pipes and conduits by slowing the flow rate to the ponds. The fouling abilities of *Hyalinella vaihirieae* were less noticeable in ponds at Kekaha that were thought to have been stocked at or near maximum density, as the prawns apparently fed on the bryozoan. The bryozoan was found to be particularly abundant as a thick growth around the edges in ponds with a low standing crop of prawns. Prawns kept in tanks with the bryozoan and not fed commercial feeds were observed to graze on the bryozoan (J. A. Brock, pers. comm.). *Macrobrachium rosenbergii* is known to be an omnivore, or a cannibalistic feeder under crowded conditions. It would be useful to know how nutritive the bryozoan is as a food item for the prawn, and whether it could be used effectively as a supplemental feed item in commercial culture systems.

NOTE ADDED IN PROOF

Hyalinella vaihirieae has recently been found growing on the carapace of a terminal male prawn at Kahuku, Oahu.

ACKNOWLEDGMENTS

We are most grateful to James A. Brock, Department of Land and Natural Resources, Hawaii, for supplying the collections of *Hyalinella vaihirieae*, for information on the Kauai prawn ponds, and for reading the manuscript. John A. Maciolek provided unpublished information on the distribution of freshwater bryozoans in the Hawaiian Islands. M. R. Fordy, University College of Swansea, kindly prepared the scanning electron micrographs. The British Museum (Natural History) loaned reference specimens of *H. vaihirieae*.

LITERATURE CITED

- BUSHNELL, J. H. 1973. The freshwater Ectopoda: A zoogeographical discussion. Pages 503–521 in G. P. Larwood, ed., Living and

- fossil Bryozoa. Academic Press, London and New York.
- HASTINGS, A. B. 1929. Notes on some little known phylactolaematous *Polyzoa* and description of a new species from Tahiti. *Ann. Mag. Nat. Hist. Ser.* 10(3):300-310.
- HYMAN, L. H. 1959. The invertebrates: Smaller coelomate groups. Vol. 5, pp. 275-515. McGraw-Hill, New York.
- LACOURT, A. W. 1968. A monograph of the freshwater Bryozoa—Phylactolaemata. *Zool. Verh., Leiden* No. 93:1-159.
- MACIOLEK, J. A. 1982. Lakes and lake-like waters of the Hawaiian Archipelago. *Occ. Pap. B.P. Bishop Mus.* 25(1):1-14.
- ODA, S. 1979. Germination of the statoblasts of *Pectinella magnifica*, a freshwater Bryozoan. Pages 93-112 in G. P. Larwood and M. P. Abbott, eds. *Advances in Bryozoology*. Academic Press, London and New York.
- ROGICK, M. D., and C. J. D. Brown. 1942. Studies on fresh-water Bryozoa XII. A collection from various sources. *Ann. N.Y. Acad. Sci.* 43:123-144.
- WIEBACH, F. 1973. Preliminary notes on a revision of the genus *Hyalinella*. Pages 539-547 in G. P. Larwood, ed. *Living and fossil Bryozoa*. Academic Press, London and New York.